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MEADOW SPITTLEBUG CONTROL WITH NEW INSECTICIDES

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Since the passage in 1954 of Public Law 518, the Miller Pesticide Residue Amendment to the Federal Food, Drug, and Cosmetic Act of 1938, it has been necessary to make changes in recommendations for control of forage insects, especially those involving the meadow spittlebug, *Philaenus spumaria* (L.) BHC, one of the most effective chemicals for spittlebug nymph control (Weaver and King 1954) (Ware 1959), had approval by the Pesticide Regulation Section before the Miller Bill was passed, and its use continued without Food and Drug approval. Heptachlor, although inferior in effectiveness to BHC, was recommended for several years, but approval has been withdrawn because of the persisting residues of its epoxide (Ward 1960).

Because of the erratic performance of heptachlor and the high cost of the federally-approved insecticide methoxychlor, it seemed advisable to continue the search for more satisfactory insecticides. This became increasingly imperative at the time it was suspected that the use of heptachlor would have to be abandoned. Lindane, which was approved in 1960, is very satisfactory although the label restrictions should be modified[1]. Data by Ware (1959) and Fahey *et al* (1960) indicate a longer interval is needed between treatment and harvest.

Endrin received federal approval in 1959 but is not recommended in Ohio because of unfavorable restrictions which preclude its effective use[2].

[1]Lindane has been approved for use on forage to be fed to dairy animals and beef cattle being finished for slaughter. It may be applied at 0.2 pound per acre at least 14 days before harvest.

[2]Endrin was approved for application at 0.125 pound per acre at least 35 days before harvest and when the crop is not more than 2 inches in height. In 1960, the height restriction on alfalfa only was raised to 4 inches.

Meadow spittlebug control measures were reviewed by Weaver and King (1954). In addition, Weaver (1956, 1958), App (1959), Shorey and Gyrisco (1959), Hansen and Dorsey (1957) and Fahey *et al.* (1960) have reported on various insecticidal test on this pest of forage crops. However, there is little published infomation on the performance of some of the more recently developed insecticides.

Materials and Methods

The treatments reported here were applied by the senior author in 1958, 1959, and 1960. Also included are unpublished data collected by the junior author in 1954, 1955, and 1956.

Ground sprays were applied by means of a Bean hydraulic sprayer mounted on a Jeep modified for spray purposes. The sprayer was equipped with a 14 foot boom and had nine Spraying Systems TeeJet nozzles fitted with 650067 discs. At a speed of 2.2 miles per hour the volume of spray per acre was 9 and 10 gallons at 30 and 40 pounds pressure per square inch, respectively. In one instance where a volume of 40 gallons per acre was desired, TeeJet 6503 discs and 58 psi. were used. Wettable powders were applied in 100 gallons of water per acre at 100 psi. using the same spray rig with appropriate nozzles for the high volume application.

Granular formulations were applied with a wheelbarrow-mounted, gear-fed, grass seed box, as illustrated by Weaver (1956). All formulations used were on 24:48 or 30:60 mesh Attaclay with the exception of one Thiodan formulation which was on Volclay.

Aerial applications were made in cooperation with the School of Aviation and the Department of Agricultural Engineering of The Ohio State University. The plane was a modified Piper Cub with the spraying system and granular distributor designed by the agricultural engineers. This equipment dispensed a spray swath 35 feet wide and a granular swath 40 feet wide.

Unless otherwise indicated, treatments described were applied at or near the optimum time for best results. This is generally considered to be the time of first appearance of second-instar nymphs (Weaver and King 1954).

Ground application plots were 25 by 50 feet and in most instances were replicated four times in randomized blocks. An alley was provided between blocks to prevent overlapping at the ends of plots. Aerial application plots were approximately 80 by 400 feet with two or three replications. Most of the experiments were conducted on mixed stands of medium red clover and alfalfa in the first cutting year.

During late May, counts of nymphs were made on 25 or 30 red clover stems taken at random from each plot. Results are presented as percent reduction from the population in untreated check plots.

Chemical definitions of proprietary materials tested are listed at the end of this paper. Dosages listed in tables are in terms of actual toxicant per acre.

Experiments and Results

The data listed in Table 1 are compilations of the results from treatments at several locations during the six years of testing.

On the basis of percent control, the insecticides showing promise were methoxychlor, phosdrin, endrin, SD3450, SD4402, Thiodan, aldrin, lindane, Guthion, Strobane, heptachlor and BHC. Heptachlor and BHC have been ruled out because of federal regulations, as mentioned previously.

Strobane and phosdrin were considered too marginal to be tested further as control was only fair at relatively high doses. From the standpoint of cost-efficiency Guthion, which generally gives satisfactory control when applied at 1 pound per acre, would not compete with the other insecticides. Methoxychlor had been extensively tested earlier (Weaver 1952) and is included in present recommendations (Blair and Treece 1961) although the cost is such that many farmers decline to use it. Aldrin is a long residual material which cannot be recommended, even though it gives a fair degree of spittlebug control. It is unlikely that endrin could compete with lindane, even if the growth restriction were removed.

Lindane is the most satisfactory insecticide now approved for use on forage for spittlebug nymph control. Good results can be expected at 0.2 pound per acre, the dosage now approved and recommended. SD4402 exhibited considerable effectiveness at 0.2 pound per acre. The residual characteristics of this compound are not yet known. SD3450 warrants further testing at higher dosages. However, it is extremely toxic to man and is unfavorable from that standpoint.

Thiodan, which was comparable in performance with BHC, was the most effective of the recently developed insecticides tested for spittlebug control. In cost it would likely compete favorably with lindane and

Table 1.– Insecticides for meadow spittlebug control. Applications made at 9 to 10 gallons per acre and 30 to 40 psi. at or near the optimum time for control. 1954 – 1960.

Insecticide and Formulation	Dosage (lb./A.)	Number of Tests	Percent Control
AC-12008 4 EC	0.25	1	0.0
AC-12009 4 EC	0.25	1	0.0
AC-12013 4 EC	0.25	1	0.0
AC-18706 2 M	1.00	1	14.0
Aldrin 2 EC	0.50	1	89.8
Bayer 29493 4 EC	1.00	1	59.8
BHC 1 EC (11% gamma)	0.25	5	94.1
	0.50	1	99.8
Delnav 2 EC	0.50	1	29.3
Delnav 4 EC	1.00	2	48.7
Diazinon 2 EC	1.00	2	51.1
Diazinon 25% WP[1]	1.00	1	16.7
Dicapthon 2 EC	1.00	1	26.4
Dimethoate 4 EC	1.00	2	8.7
Endrin 1.6 EC	0.125	1	87.6
	0.20	2	92.3
	0.25	1	100.0
Guthion 1.5 EC	0.50	4	88.9
	0.75	1	100.0
	1.00	2	98.1
Heptachlor 2 EC	0.25	1	92.5
	0.50	7	94.9
	1.00	1	98.6
Lindane 1.7 EC	0.21	2	99.3
	0.25	1	100.0
	0.50	1	100.0
Methoxychlor 2 EC	2.00	1	99.8
Methyl Trithion 4 EC	1.00	1	42.2
Niagara 908 25% WP[1]	1.00	1	23.2
Phorate 4 EC	0.50	1	10.3
Phosdrin 2 EC	0.50	1	90.7
Phosdrin actual	0.25	1	0.0
SD3110 1.6 oz. EC	0.0625	1	31.6
SD3450 4 oz. EC	0.0625	1	89.2
SD3562 10 Miscible	0.625	1	66.3
SD4402 1.25 EC	0.20	2	96.6
SD5539 2 EC	0.50	1	79.5

[1]Applied in 100 gallons of water per acre.

Table 1. – Continued Insecticided for meadow spittlebug control. Applications made at 9 to 10 gallons per acre and 30 to 40 psi. at or near the optimum time for control. 1954 – 1960.

Insecticide and Formulation	Dosage (lb./A.)	Number of Tests	Percent Control
Sevin 2 EC	0.50	1	16.1
Sevin 1 EC	2.00	1	59.8
Shell 1808 2 EC	0.25	1	17.5
Strobane 8 EC	0.25	1	85.9
	0.50	1	87.3
	0.75	2	89.3
	1.00	1	97.2
Thiodan 2 EC	0.125	5	93.9
	0.188	2	98.5
	0.25	6	98.8
	0.50	3	99.9
Thiodan 25% WP[1]	1.00	1	100.0
Trithion 4 Flowable	1.00	2	49.9
Trithion 25% WP[1]	1.00	1	26.4
UC-8305 4 EC	0.50	1	80.5

[1]Applied in 100 gallons of water per acre.

methoxychlor. The residue problem with Thiodan has not yet been clearly defined, however.

Granular formulations of certain insecticides have been shown by Weaver (1956) and Hansen and Dorsey (1957) to control meadow spittlebug nymphs adequately. Results of several experiments with granular formulations are listed in Table 2. In general, results were slightly inferior to those obtained with sprays. As granules , ½ pound of Guthion and 1 pound of Di-Syston per acre gave poor results. BHC, Thiodan, heptachlor and endrin all gave satisfactory control at the same dosages needed to produce good to excellent control when they were applied as sprays. Control with granulated Thiodan at 0.5 pound per acre was comparable to that obtained with 0.25 pound applied as a spray.

Because of its extreme effectiveness against spittlebug nymphs, Thiodan has been tested more extensively than other new insecticides. It was the most exciting development in spittlebug control since BHC, especially when first residue reports indicated a short residual life. More recent data indicate that residues may pose problems, and the situation

Table 2. – Granular formulations of insecticides for meadow spittlebug control. April 15 to May 5, 1958 – 1960.

Insecticide and Formulation	Dosage (lb./A.)	Number of Tests	Percent Control
5% Heptachlor	0.5	2	92.8
2½% Guthion	0.5	1	61.4
2% Endrin	0.2	4	94.7
5% Di-Syston	1.0	1	42.6
5% Thiodan	0.125	1	84.0
	0.25	3	90.4
	0.5	2	97.1
2% BHC	0.2	3	94.4
	0.33	1	95.3

is no longer promising. Data published by Fahey *et al.* (1960) indicate that the dissipation of Thiodan residues on forage is rapid enough that applications at 6 inches of growth should be safe. However, there has not been federal approval at the time of this writing.

One of the problems encountered in spittlebug control is that many insecticides, which give adequate control when applied at the optimum time in a low volume of water, will not perform satisfactorily when plant growth reaches 8 to 10 inches or more unless the volume of water per acre is increased greatly, BHC will adequately control spittlebug nymphs at low volumes when there is an abundance of plant growth.

Thiodan and heptachlor were tested under similar conditions. The results of treatments applied on May 7, 1958 when there were 10 to 12 inches of plant growth are listed in Table 3. It is readily apparent that Thiodan performed equally well at 10 and 40 gallons per acre, whereas heptachlor gave inadequate control at the low volume level. These results with heptachlor are typical of its past performance for farmers, many of whom did not treat at the optimum time. Thiodan was tested even later, May 21, 1959, at which time there were 21 inches of growth (Table 4). Again, in this even more severe test, Thiodan performed well, indicating that it is just as effective in late applications as when applied at the optimum time.

Results of aerial applications of sprays and granules are presented in Table 5. Thiodan was again extremely effective at all dosages and volumes applied. Heptachlor, at 0.25 pound per acre, was unsatisfactory, whereas the 0.5 pound rate gave adequate control. One problem encounter-

Table 3. — Effect of volume of spray applied on control of the meadow spittlebug. May 7, 1958.

Insecticide and Formulation	Dosage (lb./A.)	Volume (gal./A.)	Percent Control
Thiodan 2 EC	0.125	10	93.3
		40	94.5
	0.25	10	98.2
		40	96.0
	0.5	10	100.0
		40	99.4
Heptachlor 2 EC	0.5	10	82.7
		40	94.8

Table 4. — Meadow spittlebug control with a low volume, late application of Thiodan. May 21, 1959.

Insecticide and Formulation	Dosage (lb./A.)	Nymphs per 30 stems	Percent Control
Thiodan 2 EC	0.25	1.0	98.0
Check		49.5	——

Table 5. — Aerial applications of insecticides for meadow spittlebug control. 1956 — 1960.

Insecticide and Formulation	Volume Per Acre	Dosage (lb./A.)	Number of Tests	Percent Control
Granules				
2% BHC	10 lb.	0.2	1	99.6
2.5% Heptachlor	10.lb.	0.25	1	70.0
3.8% Heptachlor	13 lb.	0.5	1	92.1
1.8% Thiodan[1]	13-15 lb.	0.25	2	92.0
3.5% Thiodan[1]	13-15 lb.	0.5	3[2]	98.6
Sprays				
Thiodan 2 EC	2 gallons	0.25	2	99.5
	4 gallons	0.25	1	93.8
	2 gallons	0.5	2	100.0
	4 gallons	0.5	2	99.5

[1]Approximate percent.

[2]One application was made with the toxicant on Volclay. All other granular formulations were on Attaclay.

ed in experimental tests with aerially-applied Thiodan is that a considerable reduction in the spittlebug population occurred outside the test area although there was little or no observable drift. This phenomenon occurred in all tests where Thiodan was applied.

Conclusions

Thirty-one insecticides were tested for control of spittlebug nymphs. Of these, BHC and heptachlor do not have federal approval; endrin is approved but not recommended in Ohio because of the unrealistic label restrictions; Methoxychlor is approved and recommended but little used because of cost. Methoxychlor is most useful for applications after the time lindane can be safely applied. Farmer acceptance of lindane remains to be observed. The only complaint foreseen is the necessity for early applications. Lindane's price and performance should be satisfactory.

Of the remaining insecticides tested, Thiodan is most likely to be used in a practical spittlebug control program. Additional information is required to establish its residual characteristics on forage after which the granting of a favorable label would be necessary. SD4402 and SD3450 are worthy of futher investigation on the basis of limited data on control.

Although foliage sprays are consistently more effective than granular applications, the latter will give satisfactory control of spittlebug nymphs.

Aerial applications of both sprays and granules of suitable insecticides were demonstrated to give excellent spittlebug control.

CHEMICAL DEFINITIONS OF PROPRIETARY MATERIALS

AC-12008	O,O-diethyl S-isopropylthiomethyl phosphorodithioate
AC-12009	O,O-diethyl S-*n*-propylthiomethyl phosphorodithioate
AC-12013	O,O-diisopropyl S-isopropylthiomethyl phosphorodithioate
AC-18706	O,O-dimethyl S-(N-ethylcarbamoylmethyl) phosphorodithioate
Bayer 29493	O,O-dimethyl O-(4-(methylthio)-*m*-tolyl) phosphorothioate
Delnav	2,3-*p*-dioxanedithiol S,S-bis (O,O-dimethyl phosphorodithioate)
Diazinon	O,O-diethyl O-(2-isopropyl-6-methyl-4-pyrimidyl) thiophosphate

Di-Syston	O,O-diethyl S-2-(ethylthio)ethyl phosphorodithioate
Guthion	O,O-dimethyl S-4-oxo-1,2,3-benzotriazin-3 (4H)-ylmethyl phosphorodithioate
Methyl Trithion	O,O-dimethyl S-((*p*-chlorophenylthio)methyl) phosphorodithioate
Niagara 908	Ethyl thioperoxydiphosphate compound with copper isopropyl phosphorodithioate
Phosdrin	1-methoxycarbonyl-1-propen-2-yl dimethyl phosphate
SD3110	5,6,7,8,9,9-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-dimethanophthalazine
SD3450	5,6,7,8,9,9-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-dimethanophthalazine 2-oxide
SD3562	2-dimethylcarbamoyl-1-methylvinyl dimethyl phosphate
SD4402	1,3,4,5,6,7,8,8 octachloro 3a,4,7,7a-tetrahydro-4,-methanophthalan
SD5539	m-Nitrobenzyl 3-(dimethoxyphosphinyloxy) crotonate
Sevin	1-naphthyl N-methylcarbamate
Shell OS1808	2-carbethoxy-1-methylvinyl diethyl phosphate
Strobane	terpene polychlorinates (65% chlorine)
Thiodan	6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin 3-oxide
Trithion	S-((*p*-chlorophenylthio)methyl) O,O-diethyl phosphorodithioate
UC-8305	P-chloro-2,4-dioxa-5-methyl-P-thiono-3-phosphabicyclo (4.4.0) decane

5-62-3M